THEREFORE WHAT IS CLAIMED IS:

1. An optical performance monitor, comprising:

a first length of optical fiber having a fiber Bragg grating array of spatially -separated co-located fiber Bragg gratings, each co-located fiber Bragg grating including at least two fiber Bragg gratings, each of the at least two fiber Bragg gratings having a different associated Bragg wavelength written at the same physical location in the first length of optical fiber;

an optical branching device having an input port being optically coupled to input optical signals contained in a pre-selected number of wavelength bands, each wavelength band containing a pre-selected number of wavelength channels, the optical branching device having a first circulating port being optically coupled to a first end of the first length of optical fiber, a second end of the length of optical fiber being a low reflection termination;

an optical band demultiplexer having an input optically coupled to an output port of the optical branching device and multiple outputs corresponding to the number of wavelength bands with each output being optically coupled to an associated detector;

tuning means attached to each co-located fiber Bragg grating for inducing a pre-selected amount of change in both fiber Bragg grating period and refractive index shifting the associated Bragg wavelengths of each of the at least two fiber Bragg gratings in each co-located fiber Bragg grating to coincide with an associated pre-selected wavelength channel from each

wavelength band such that each of the at least two fiber Bragg gratings of the pre-selected co-located fiber Bragg grating reflects its associated pre-selected wavelength channel back to the optical branching device,

wherein when the co-located fiber Bragg gratings are tuned to an "off" state the input wavelength channels are routed from the optical branching device into the first end of the first length of optical fiber through the fiber Bragg grating array and terminated at the second end of the fiber Bragg grating array,

and wherein when a pre-selected co-located fiber Bragg grating is tuned to an "on" state to coincide with its pre-selected wavelength channels, each of the at least two fiber Bragg gratings of the pre-selected co-located fiber Bragg grating reflects these input wavelength channels back through the optical branching device and lunched into the optical band demultiplexer, when outputted from the optical band demultiplexer, these reflected wavelength channels are directed into their associated detectors, whereupon the wavelength channels of each wavelength band are interrogated to determine pre-selected properties of the input optical signals, wherein the co-located fiber Bragg gratings are tuned to the "on" state one at a time so that all wavelength channels are reflected to the associated detector in a time-division manner.

2. An optical performance monitor according to claim 1 wherein the pre-selected properties of the wavelength channels including wavelength channel

identification, wavelength channel power and wavelength channel optical-signal-to-noise-ratio.

3. An optical performance monitor according to claim 1 wherein the optical branching device includes an optical circulator.

4. An optical performance monitor according to claim 1 wherein the optical branching device includes an optical coupler in conjunction with an optical isolator.

5. An optical performance monitor according to claim 1 wherein the detectors are individual discrete detectors.

6. An optical performance monitor according to claim 1 wherein the detectors are part of a single detector-array.

7. An optical performance monitor according to claim 1 wherein the optical band demultiplexer includes a fiber optic filter array including fiber optic branches with each fiber optic branch having fiber Bragg gratings, the fiber Bragg gratings in each fiber optic branch having Bragg wavelengths selected to transmit only one wavelength band at an output of each branch of the fiber optic branches, and wherein the output of each branch is optically coupled to one of the associated detectors so optical signals from each

wavelength band are interrogated independently of all remaining wavelength bands.

8. An optical performance monitor according to claim 7 wherein the number of pre-selected number of wavelength bands is K, and wherein the fiber optic filter array includes a 1 × K optic splitter having an input connected to the output port of the optical branching device and K output branches each having all pre-selected wavelength bands routed therein, wherein each of the K output branches includes a broadband fiber Bragg grating to transmit one of the wavelength bands and reflect all remaining wavelength bands followed by a narrowband fiber Bragg grating to provide a sharp filtering edge so that substantially square zero-skipped filtering is achieved at a boundary between the transmitted wavelength band and the reflected wavelength bands, and wherein each of the K output branches is optically coupled to one of the associated detectors, and wherein each of the K output branches transmits a different wavelength band than all the other K output branches so that all wavelength bands are output from the optical band demultiplexer.

9. An optical performance monitor according to claim 7 wherein the number of pre-selected number of wavelength bands is K, and wherein the fiber optic filter array includes multiple cascaded 1 × 2 optical splitters with an output of each 1 x 2 optical splitter connected to a broadband fiber Bragg grating followed by a narrowband fiber Bragg grating, wherein the output of

each narrowband fiber Bragg grating is connected an input of the next 1 x 2 optical splitter in the fiber optic array or to one of the associated detectors, wherein the total number of splitting stages is selected to give sufficient fiber optic branches so that all the pre-selected number of wavelength bands K are individually output from the fiber optic array to its associated detector.

10. An optical performance monitor according to claim 1 including optical switches inserted between the co-located fiber Bragg gratings for effectively separating and correcting intra-band cross talk by sequentially switching each optical switch.

11. An optical performance monitor according to claim 10 wherein the pre-selected properties of the wavelength channels including wavelength channel identification, wavelength channel power and wavelength channel optical-signal-to-noise-ratio.

12. An optical performance monitor according to claim 10 wherein the optical branching device includes an optical circulator.

13. An optical performance monitor according to claim 10 wherein the optical branching device includes an optical coupler in conjunction with an optical isolator.

14. An optical performance monitor according to claim 10 wherein the detectors are individual discrete detectors.

15. An optical performance monitor according to claim 10 wherein the detectors are part of a single detector-array.

16. An optical performance monitor according to claim 10 wherein the optical band demultiplexer includes a fiber optic filter array including fiber optic branches with each fiber optic branch having fiber Bragg gratings, the fiber Bragg gratings in each fiber optic branch having Bragg wavelengths selected to transmit only one wavelength band at an output of each branch of the fiber optic branches, and wherein the output of each branch is optically coupled to one of the associated detectors so optical signals from each wavelength band are interrogated independently of all remaining wavelength bands.

17. An optical performance monitor according to claim 16 wherein the number of pre-selected number of wavelength bands is K, and wherein the fiber optic filter array includes a 1 × K optic splitter having an input connected to the output port of the optical branching device and K output branches each having all pre-selected wavelength bands routed therein, wherein each of the K output branches includes a broadband fiber Bragg grating to transmit one of the wavelength bands and reflect all remaining wavelength bands followed by

a narrowband fiber Bragg grating to provide a sharp filtering edge so that substantially square zero-skipped filtering is achieved at a boundary between the transmitted wavelength band and the reflected wavelength bands, and wherein each of the K output branches is optically coupled to one of the associated detectors, and wherein each of the K output branches transmits a different wavelength band than all the other K output branches so that all wavelength bands are output from the optical band demultiplexer.

18. An optical performance monitor according to claim 16 wherein the number of pre-selected number of wavelength bands is K, and wherein the fiber optic filter array includes multiple cascaded 1 × 2 optical splitters with an output of each 1 x 2 optical splitter connected to a broadband fiber Bragg grating followed by a narrowband fiber Bragg grating, wherein the output of each narrowband fiber Bragg grating is connected an input of the next 1 x 2 optical splitter in the fiber optic array or to one of the associated detectors, wherein the total number of splitting stages is selected to give sufficient fiber optic branches so that all the pre-selected number of wavelength bands K are individually output from the fiber optic array to its associated detector.

19. An optical performance monitor according to claim 1 including a second length of optical fiber having a fiber Bragg grating array being substantially identical to the fiber Bragg grating array in the first length of optical fiber, the second length of optical fiber being optically coupled to a

second circulating port of the optical branching device, wherein the input optical signals are reflected by the first and then the second co-located fiber Bragg grating array to form a "double pass" filtering effect for reducing power measurement error.

20. An optical performance monitor according to claim 19 including optical switches inserted between the co-located fiber Bragg gratings in the first and the second length of optical fibers for effectively separating and correcting intra-band cross talk by sequentially switching each optical switch in the fiber Bragg grating array in each of the first and the second lengths of optical fiber.

21. An optical performance monitor, comprising:

a) a optical isolator having an input optically coupled to input optical signals contained in a pre-selected number of wavelength bands, each wavelength band containing a pre-selected number of wavelength channels, the optical isolator having an output optically coupled to a input of an optical band demultiplexer, the optical band demultiplexer having multiple outputs with each output being optically coupled to a multiple input port/single output port optical switch for passing a pre-selected wavelength band of input wavelength channels;

b) an optical branching device having an input port optically coupled to the single output port of the optical switch, the optical branching device having a first circulating port being optically coupled to a first end of a first

length of optical fiber, the optical branching device having an output port optically coupled to a detector;

c) the first length of optical fiber having a fiber Bragg grating array of spatially -separated co-located fiber Bragg gratings, each co-located fiber Bragg grating including at least two fiber Bragg gratings, each of the at least two fiber Bragg gratings having a different associated Bragg wavelength written at the same physical location in the first length of optical fiber, the first length of optical fiber having a second end being a low reflection termination;

d) tuning means attached to each co-located fiber Bragg grating for inducing a pre-selected amount of change in both fiber Bragg grating period and refractive index for shifting the associated Bragg wavelengths of each of the at least two fiber Bragg gratings in each co-located fiber Bragg grating to coincide with an associated pre-selected input wavelength channel from each wavelength band such that each of the at least two fiber Bragg grating of the pre-selected co-located fiber Bragg grating reflects its associated pre-selected wavelength channel back through the optical branching device;

e) wherein when the co-located fiber Bragg gratings are tuned to an "off" state the input optical signals are routed from the optical branching device into the first end of the first length of optical fiber through the fiber Bragg grating array and terminated at the second end of the fiber Bragg grating array,

f) wherein for each pre-selected band, a pre-selected co-located fiber Bragg grating is tuned to reflect wavelength channels one at a time

back through the first coupling port and out through the output port of the optical branching device into the detector whereupon the wavelength channel is interrogated to determine pre-selected properties of the wavelength channel, without inter-band cross talk;

g) and wherein step f) is repeated for each of the pre-selected number of spatially -separated co-located fiber Bragg gratings; and

h) repeating steps f) and g) for each of the pre-selected number of wavelength bands until all the wavelength channels are detected.

22. An optical performance monitor according to claim 21 wherein the pre-selected properties of the wavelength channels including wavelength channel identification, wavelength channel power and wavelength channel optical-signal-to-noise-ratio.

23. An optical performance monitor according to claim 21 wherein the optical branching device is an optical circulator.

24. An optical performance monitor according to claim 21 wherein the optical branching device is an optical coupler.

25. An optical performance monitor according to claim 21 wherein the optical band demultiplexer includes a fiber optic filter array including fiber optic branches with each fiber optic branch having fiber Bragg gratings, the fiber Bragg gratings in each fiber optic branch having Bragg wavelengths

selected to transmit only one wavelength band at an output of each branch of the fiber optic branches, and wherein the output of each branch is optically coupled to one of the associated detector so optical signals from each wavelength band are interrogated independently of all remaining wavelength bands.

26. An optical performance monitor according to claim 26 wherein the number of pre-selected number of wavelength bands is K, and wherein the fiber optic filter array includes a 1 × K optic splitter having an input connected to the output port of the optical branching device and K output branches each having all pre-selected wavelength bands routed therein, wherein each of the K output branches includes a broadband fiber Bragg grating to transmit one of the wavelength bands and reflect all remaining wavelength bands followed by a narrowband fiber Bragg grating to provide a sharp filtering edge so that substantially square zero-skipped filtering is achieved at a boundary between the transmitted wavelength band and the reflected wavelength bands, and wherein each of the K output branches is optically coupled to one of the associated detectors, and wherein each of the K output branches transmits a different wavelength band than all the other K output branches so that all wavelength bands are output from the optical band demultiplexer.

27. An optical performance monitor according to claim 25 wherein the number of pre-selected number of wavelength bands is K, and wherein the

fiber optic filter array includes multiple cascaded 1 × 2 optical splitters with an output of each 1 x 2 optical splitter connected to a broadband fiber Bragg grating followed by a narrowband fiber Bragg grating, wherein the output of each narrowband fiber Bragg grating is connected an input of the next 1 x 2 optical splitter in the fiber optic array or to one of the associated detectors, wherein the total number of splitting stages is selected to give sufficient fiber optic branches so that all the pre-selected number of wavelength bands K are individually output from the fiber optic array to its associated detector.

28. An optical performance monitor, comprising:

a) an optical isolator having an output optically coupled to a input of a means for demultiplexing the input optical signals into a pre-selected number of wavelength bands, each wavelength band containing a pre-selected number of wavelength channels, the optical isolator having an input optically coupled to the input optical signals, the means for demultiplexing the optical signals having a number of outputs equal to the pre-selected number of wavelength bands with each output being optically coupled into an associated optical branching device, each optical branching device having a first circulating port being optically coupled to a first end of an associated length of optical fiber, each optical branching device having an output port optically coupled to an associated detector;

each length of optical fiber having a fiber Bragg grating array including a pre-selected number of spatially -separated fiber Bragg gratings, each of

the pre-selected number of fiber Bragg gratings having a different associated Bragg wavelength, the length of optical fiber having a second end being a low reflection termination;

tuning means attached to each of the pre-selected number of spatially -separated fiber Bragg gratings for inducing a pre-selected amount of change in both fiber Bragg grating period and refractive index in each fiber Bragg grating for shifting the associated Bragg wavelengths of each of the pre-selected number of fiber Bragg gratings among a pre-selected number (L) of positions, wherein when a pre-selected fiber Bragg grating in each length of optical fiber is switched to coincide with a pre-selected wavelength channel, the pre-selected wavelength channels in each fiber are reflected back through the optical branching device attached to each length of optical fiber and out through its output port into the associated detector connected thereto, whereupon the wavelength channels of each wavelength band are interrogated to determine pre-selected properties of the optical signals.

29. An optical performance monitor according to claim 28 wherein the means for demultiplexing the input optical signals is an optical band demultiplexer.

30. An optical performance monitor according to claim 28 wherein the means for demultiplexing the input optical signals is a 1x K optical splitter in

which K is the pre-selected number of wavelength bands, and wherein the fiber Bragg gratings have a pre-selected out-of-band rejection ratio.

31. An optical performance monitor according to claim 28 wherein each optical fiber has the same number of spatially-separated fiber Bragg gratings, each spatially-separated fiber Bragg grating in different optical fibers but in the same corresponding fiber positions being attached to a common tuning means such that all the fiber Bragg gratings in the same corresponding fiber positions are switched at the same time.

32. An optical performance monitor according to claim 28 wherein the pre-selected properties of the wavelength channels including wavelength channel identification, wavelength channel power and wavelength channel optical-signal-to-noise-ratio.

33. An optical performance monitor according to claim 28 wherein the optical branching device is an optical circulator.

34. An optical performance monitor according to claim 28 wherein the optical branching device includes an optical coupler.

35. An optical performance monitor according to claim 28 wherein the detectors are individual discrete detectors.

36. An optical performance monitor according to claim 28 wherein the detectors are part of a single detector-array.

37. An optical performance monitor according to claim 28 wherein the optical band demultiplexer includes a fiber optic filter array including fiber optic branches with each fiber optic branch having fiber Bragg gratings, the fiber Bragg gratings in each fiber optic branch having Bragg wavelengths selected to transmit only one wavelength band at an output of each branch of the fiber optic branches, and wherein the output of each branch is optically coupled to one of the associated detector so optical signals from each wavelength band are interrogated independently of all remaining wavelength bands.

38. An optical performance monitor according to claim 37 wherein the number of pre-selected number of wavelength bands is K, and wherein the fiber optic filter array includes a 1 × K optic splitter having an input connected to the output port of the optical branching device and K output branches each having all pre-selected wavelength bands routed therein, wherein each of the K output branches includes a broadband fiber Bragg grating to transmit one of the wavelength bands and reflect all remaining wavelength bands followed by a narrowband fiber Bragg grating to provide a sharp filtering edge so that substantially square zero-skipped filtering is achieved at a boundary between the transmitted wavelength band and the reflected wavelength bands, and

wherein each of the K output branches is optically coupled to one of the associated detectors, and wherein each of the K output branches transmits a different wavelength band than all the other K output branches so that all wavelength bands are output from the optical band demultiplexer.

39. An optical performance monitor according to claim 37 wherein the number of pre-selected number of wavelength bands is K, and wherein the fiber optic filter array includes multiple cascaded 1 × 2 optical splitters with an output of each 1 x 2 optical splitter connected to a broadband fiber Bragg grating followed by a narrowband fiber Bragg grating, wherein the output of each narrowband fiber Bragg grating is connected an input of the next 1 x 2 optical splitter in the fiber optic array or to one of the associated detectors, wherein the total number of splitting stages is selected to give sufficient fiber optic branches so that all the pre-selected number of wavelength bands K are individually output from the fiber optic array to its associated detector.

40. A method of monitoring optical performance of optical signals in an optical fiber, comprising the steps of:

a) directing optical signals contained in a pre-selected number of wavelength bands into an optical branching device and into a first length of optical fiber coupled thereto, each wavelength band containing a pre-selected number of wavelength channels, the first length of optical fiber having a fiber Bragg grating array including a pre-selected number (M) of spatially -

separated co-located fiber Bragg gratings, each co-located fiber Bragg grating including a pre-selected number (K) of fiber Bragg gratings at least equal to the pre-selected number of wavelength bands, each of the pre-selected number (K) of fiber Bragg gratings having a different associated Bragg wavelength written at the same physical location in the first length of optical fiber and each Bragg wavelength of the (K) fiber Bragg grating being tunable among a pre-selected number (L) of wavelength positions, the first length of optical fiber having a second end being a low reflection termination;

b) tuning both the period and refractive index of a pre-selected co-located fiber Bragg grating for shifting the associated Bragg wavelengths of each of the pre-selected number of fiber Bragg gratings into one of the (L) wavelength positions to coincide with an associated pre-selected input wavelength channel from each wavelength band such that each fiber Bragg grating of the pre-selected co-located fiber Bragg grating reflects its associated pre-selected wavelength channel back through the optical branching device, and

c) demultiplexing the reflected pre-selected wavelength channels and simultaneously detecting the reflected pre-selected input wavelength channels from each wavelength band and interrogating the detected wavelength channels to determine pre-selected properties of the optical signals;

d) repeating steps b) and c) L-1 additional times until L wavelength channels in each wavelength band have been reflected back through the optical branching device; and

e) repeating steps b), c) and d) for each of the pre-selected number (M) of spatially -separated co-located fiber Bragg gratings until all the wavelength channels (N), given by N=MKL are detected.

41. A method according to claim 40 wherein the pre-selected properties of the wavelength channels including wavelength channel identification, wavelength channel power and wavelength channel optical-signal-to-noise-ratio.

42. A method according to claim 40 wherein the optical branching device is an optical circulator.

43. A method according to claim 40 wherein the optical branching device is an optical coupler in conjunction with an optical isolator.

44. A method according to claim 40 wherein the step of detecting is performed using individual discrete detectors.

45. A method according to claim 40 wherein the step of detecting is performed using detectors which are part of a single detector-array.

46. A method according to claim 40 wherein the step of demultiplexing the includes splitting and reproducing the optical signals in all the pre-selected wavelength bands in a pre-selected number of fiber optic branches, and filtering the optical signals in each of the pre-selected fiber optic branches to transmit only one of the pre-selected wavelength bands and reflect all the other pre-selected wavelength bands, wherein each fiber optic branch transmits a different pre-selected wavelength band from all the others so that each of the wavelength bands are output from the pre-selected number of fiber optic branches.

47. A method according to claim 46 wherein the number of pre-selected wavelength bands is K, and wherein the fiber optic branches are formed using a $1 \times K$ optic splitter having an input connected to an output port of the optical branching device and K output branches each having all pre-selected wavelength bands routed therein, wherein each of the K output branches includes a broadband fiber Bragg grating to transmit one of the wavelength bands and reflect all remaining wavelength bands followed by a narrowband fiber Bragg grating to provide a sharp filtering edge so that substantially square zero-skipped filtering is achieved at a boundary between the transmitted wavelength band and the reflected wavelength bands, and wherein each of the K output branches is optically coupled to one of the associated detectors, and wherein each of the K output branches transmits a

different wavelength band than all the other K output branches so that all wavelength bands are output from the optical band demultiplexer.

48. A method according to claim 46 wherein the number of pre-selected wavelength bands is K, and wherein the fiber optic branches are formed using multiple cascaded 1 × 2 optical splitters with an output of each 1 x 2 optical splitter connected to a broadband fiber Bragg grating followed by a narrowband fiber Bragg grating, wherein the output of each narrowband fiber Bragg grating is connected an input of the next 1 x 2 optical splitter in the fiber optic array or to one of the associated detectors, wherein the total number of splitting stages is selected to give sufficient fiber optic branches so that all the pre-selected number of wavelength bands K are individually output from the fiber optic array to an associated detector.

49. The method according to claim 40 wherein step a) includes optically isolating each pre-selected co-located fiber Bragg grating from the remaining co-located fiber Bragg gratings located downstream of the pre-selected co-located fiber Bragg grating from the optical branching device in the first length of optical fiber for effectively separating and correcting intra-band cross talk.

50. The method according to claim 49 wherein the step of optically isolating each pre-selected co-located fiber Bragg grating from the remaining

co-located fiber Bragg is achieved by presence of optical switches located in the first length of optical fiber between each co-located fiber Bragg grating.

51. A method according to claim 49 wherein the step of demultiplexing the includes splitting and reproducing the optical signals in all the pre-selected wavelength bands in a pre-selected number of fiber optic branches, and filtering the optical signals in each of the pre-selected fiber optic branches to transmit only one of the pre-selected wavelength bands and reflect all the other pre-selected wavelength bands, wherein each fiber optic branch transmits a different pre-selected wavelength band from all the others so that each of the wavelength bands are output from the pre-selected number of fiber optic branches.

52. An optical performance monitor according to claim 51 wherein the number of pre-selected number of wavelength bands is K, and wherein the fiber optic filter array includes a 1 × K optic splitter having an input connected to the output port of the optical branching device and K output branches each having all pre-selected wavelength bands routed therein, wherein each of the K output branches includes a broadband fiber Bragg grating to transmit one of the wavelength bands and reflect all remaining wavelength bands followed by a narrowband fiber Bragg grating to provide a sharp filtering edge so that substantially square zero-skipped filtering is achieved at a boundary between the transmitted wavelength band and the reflected wavelength bands, and

wherein each of the K output branches is optically coupled to one of the associated detectors, and wherein each of the K output branches transmits a different wavelength band than all the other K output branches so that all wavelength bands are output from the optical band demultiplexer.

53. An optical performance monitor according to claim 51 wherein the number of pre-selected number of wavelength bands is K, and wherein the fiber optic filter array includes multiple cascaded 1 × 2 optical splitters with an output of each 1 x 2 optical splitter connected to a broadband fiber Bragg grating followed by a narrowband fiber Bragg grating, wherein the output of each narrowband fiber Bragg grating is connected an input of the next 1 x 2 optical splitter in the fiber optic array or to one of the associated detectors, wherein the total number of splitting stages is selected to give sufficient fiber optic branches so that all the pre-selected number of wavelength bands K are individually output from the fiber optic array to its associated detector.

54. The method according to claim 40 including a second length of optical fiber having a fiber Bragg grating array being substantially identical to the fiber Bragg grating array in the first length of optical fiber, the second length of optical fiber being optically coupled to the optical branching device, and wherein steps a), b), c) and d) are performed simultaneously for the same corresponding pre-selected co-located grating in each of the first and second lengths of fiber, and wherein the optical signals in the wavelength channels

are reflected by the first and then the second co-located fiber Bragg grating array to form a “double pass” filtering effect for reducing power measurement error.

55. The method according to claim 54 wherein step a) includes physically isolating each pre-selected co-located fiber Bragg grating in the first and second optical fibers from the remaining co-located fiber Bragg gratings located downstream of the pre-selected co-located fiber Bragg grating and the optical branching device in the first and second lengths of optical fiber for effectively separating and correcting intra-band cross talk.

56. A method according to claim 54 wherein the step of demultiplexing the includes splitting and reproducing the optical signals in all the pre-selected wavelength bands in a pre-selected number of fiber optic branches, and filtering the optical signals in each of the pre-selected fiber optic branches to transmit only one of the pre-selected wavelength bands and reflect all the other pre-selected wavelength bands, wherein each fiber optic branch transmits a different pre-selected wavelength band from all the others so that each of the wavelength bands are output from the pre-selected number of fiber optic branches.

57. A method according to claim 56 wherein filtering the optical signals in each of the pre-selected fiber optic branches is achieved by fiber Bragg

gratings in each fiber optic branch having Bragg wavelengths selected to transmit only one wavelength band.

58. A method according to claim 57 wherein the fiber Bragg gratings includes at least one broad band fiber Bragg grating in each fiber optic branch for transmitting only one of the pre-selected wavelength bands, and a narrow band fiber Bragg grating located downstream of the broad band fiber Bragg grating in each fiber optic branch to provide a sharp filtering edge so that substantially square zero-skipped filtering is achieved at a boundary between the transmitted and reflected wavelength bands.

59. A method of monitoring optical performance of optical signals in an optical fiber, comprising the steps of:

a) demultiplexing optical signals contained in a pre-selected number of wavelength bands, each wavelength band containing a pre-selected number of wavelength channels;

b) directing demultiplexed optical signals from one of the pre-selected wavelength bands into an optical branching device and into a first length of optical fiber coupled thereto, each wavelength band containing a pre-selected number of wavelength channels, the first length of optical fiber having a fiber Bragg grating array including a pre-selected number (M) of spatially - separated co-located fiber Bragg gratings, each co-located fiber Bragg grating including a pre-selected number (K) of fiber Bragg gratings at least equal to

the pre-selected number of wavelength bands, each of the pre-selected number (K) of fiber Bragg gratings having a different associated Bragg wavelength written at the same physical location in the first length of optical fiber and each Bragg wavelength of the (K) fiber Bragg grating being tunable among a pre-selected number (L) of wavelength positions, the first length of optical fiber having a second end being a low reflection termination;

c) tuning both the period and refractive index of one of the pre-selected number (K) of fiber Bragg gratings in one of the pre-selected number (M) of spatially -separated co-located fiber Bragg gratings for shifting the associated Bragg wavelength of the pre-selected fiber Bragg grating into one of the (L) wavelength positions to coincide with an associated pre-selected wavelength channel from the pre-selected wavelength band such that the pre-selected fiber Bragg grating of the pre-selected co-located fiber Bragg grating reflects the associated pre-selected wavelength channel back through the optical branching device, and detecting the reflected pre-selected wavelength channel and interrogating the detected wavelength channel to determine pre-selected properties of the optical signals contained therein;

d) repeating step c) L-1 additional times until all L wavelength channels in the pre-selected wavelength band have been reflected back through the optical branching device;

e) repeating steps c) and d) for each of the pre-selected number (M) of spatially -separated co-located fiber Bragg gratings; and

f) repeating steps b), c) d) and e) for each of the pre-selected number of wavelength bands until all the wavelength channels (N), given by N=MKL, are detected.

60. A method according to claim 59 wherein the pre-selected properties of the wavelength channels including wavelength channel identification, wavelength channel power and wavelength channel optical-signal-to-noise-ratio.

61. A method according to claim 59 wherein the optical branching device is an optical circulator.

62. A method according to claim 59 wherein the optical branching device is an optical coupler.

63. A method according to claim 59 wherein the step of detecting is performed using individual discrete detectors.

64. A method according to claim 59 wherein the step of detecting is performed using detectors which are part of a single detector-array.

65. A method according to claim 59 wherein the step of demultiplexing the includes splitting and reproducing the optical signals in all the pre-selected

wavelength bands in a pre-selected number of fiber optic branches, and filtering the optical signals in each of the pre-selected fiber optic branches to transmit only one of the pre-selected wavelength bands and reflect all the other pre-selected wavelength bands, wherein each fiber optic branch transmits a different pre-selected wavelength band from all the others so that each of the wavelength bands are output from the pre-selected number of fiber optic branches.

66. A method according to claim 65 wherein the number of pre-selected wavelength bands is K, and wherein the fiber optic branches are formed using a 1 $\times$ K optic splitter having an input connected to an output port of the optical branching device and K output branches each having all pre-selected wavelength bands routed therein, wherein each of the K output branches includes a broadband fiber Bragg grating to transmit one of the wavelength bands and reflect all remaining wavelength bands followed by a narrowband fiber Bragg grating to provide a sharp filtering edge so that substantially square zero-skipped filtering is achieved at a boundary between the transmitted wavelength band and the reflected wavelength bands, and wherein each of the K output branches is optically coupled to one of the associated detectors, and wherein each of the K output branches transmits a different wavelength band than all the other K output branches so that all wavelength bands are output from the optical band demultiplexer.

67. A method according to claim 65 wherein the number of pre-selected wavelength bands is K, and wherein the fiber optic branches are formed using at least one cascaded 1 × 2 optical splitters with an output of each 1 x 2 optical splitter connected to a broadband fiber Bragg grating followed by a narrowband fiber Bragg grating, wherein the output of each narrowband fiber Bragg grating is connected an input of the next 1 x 2 optical splitter in the fiber optic array or to one of the associated detectors, wherein the total number of splitting stages is selected to give sufficient fiber optic branches so that all the pre-selected number of wavelength bands K are individually output from the fiber optic array to an associated detector.

68. A method of monitoring optical performance of optical signals in an optical fiber, comprising the steps of:

a) demultiplexing optical signals into a pre-selected number (K) of wavelength bands, each wavelength band containing a pre-selected number of wavelength channels;

b) directing the demultiplexed wavelength channels from each of the pre-selected number (K) wavelength bands into an associated optical branching device and into an length of optical fiber coupled thereto, each length of optical fiber having a fiber Bragg grating array including a pre-selected number (M) of spatially -separated number of fiber Bragg gratings, each of the pre-selected number of fiber Bragg gratings having a different associated Bragg wavelength and being tunable among a pre-selected

number (L) of wavelength positions with each wavelength position coinciding with an associated pre-selected wavelength channel from the wavelength band routed into the length of optical fiber such that each fiber Bragg grating reflects its (L) pre-selected wavelength channels back through the optical branching device attached thereto, the length of optical fiber having a second end being a low reflection termination;

c)) tuning both the period and refractive index of one of the pre-selected number (M) of fiber Bragg gratings in each of the optical fibers for shifting the associated Bragg wavelength of each fiber Bragg grating to coincide with an associated pre-selected wavelength channel from the pre-selected wavelength band such that the pre-selected fiber Bragg grating reflects the associated pre-selected wavelength channel back through its associated optical branching device, and detecting the reflected pre-selected wavelength channel from each wavelength band and interrogating the detected wavelength channels to determine pre-selected properties of the optical signals contained therein;

d) repeating step c) L-1 additional times until L wavelength channels in the pre-selected wavelength band in each length of optical fiber has been reflected back through the optical branching device; and

e) repeating steps c) and d) for each of the pre-selected number (M) of spatially -separated Bragg gratings in each length of optical fiber until all the wavelength channels have been detected;

f) repeating steps b), c) d) and e) for each of the pre-selected number (K) of wavelength bands until all the wavelength channels (N), given by N=MKL, are detected.

69. The method according to claim 68 wherein each optical fiber has the same number of spatially-separated fiber Bragg gratings, each spatially-separated fiber Bragg grating in different optical fibers but in the same corresponding fiber positions being attached to a common tuning means such that all the fiber Bragg gratings in the same corresponding fiber positions are switched at the same time.

70. The method according to claim 88 wherein the optical branching device is an optical circulator.

71. The method according to claim 68 wherein the optical branching device is an optical coupler.

72. The method according to claim 68 wherein the step of detecting is performed using individual discrete detectors.

73. The method according to claim 68 wherein the step of detecting is performed using detectors which are part of a single detector-array.

74. A method according to claim 68 wherein the step of demultiplexing the includes splitting and reproducing the optical signals in all the pre-selected wavelength bands in a pre-selected number of fiber optic branches, and filtering the optical signals in each of the pre-selected fiber optic branches to transmit only one of the pre-selected wavelength bands and reflect all the other pre-selected wavelength bands, wherein each fiber optic branch transmits a different pre-selected wavelength band from all the others so that each of the wavelength bands are output from the pre-selected number of fiber optic branches.

75. A method according to claim 74 wherein the number of pre-selected wavelength bands is K, and wherein the fiber optic branches are formed using a 1 × K optic splitter having an input connected to an output port of the optical branching device and K output branches each having all pre-selected wavelength bands routed therein, wherein each of the K output branches includes a broadband fiber Bragg grating to transmit one of the wavelength bands and reflect all remaining wavelength bands followed by a narrowband fiber Bragg grating to provide a sharp filtering edge so that substantially square zero-skipped filtering is achieved at a boundary between the transmitted wavelength band and the reflected wavelength bands, and wherein each of the K output branches is optically coupled to one of the associated detectors, and wherein each of the K output branches transmits a

different wavelength band than all the other K output branches so that all wavelength bands are output from the optical band demultiplexer.

76. A method according to claim 74 wherein the number of pre-selected wavelength bands is K, and wherein the fiber optic branches are formed using at least one cascaded 1 × 2 optical splitters with an output of each 1 x 2 optical splitter connected to a broadband fiber Bragg grating followed by a narrowband fiber Bragg grating, wherein the output of each narrowband fiber Bragg grating is connected an input of the next 1 x 2 optical splitter in the fiber optic array or to one of the associated detectors, wherein the total number of splitting stages is selected to give sufficient fiber optic branches so that all the pre-selected number of wavelength bands K are individually output from the fiber optic array to an associated detector.